
Davallia napoensis, a New Species of Davalliaceae from Guangxi, China

Wang Fa-Guo, Chen Hong-Feng, and Xing Fu-Wu

Key Laboratory of Plant Resources Conservation and Sustainable Utilization, South China Botanical Garden, Chinese Academy of Sciences, 510650 Guangzhou, Guangdong, People's Republic of China. Author for correspondence: xinfw@scib.ac.cn

ABSTRACT. During preparation of the taxonomic treatment of Davalliaceae for the *Flora of China*, it was noticed that specimens of *Davallia* Sm. collected from Guangxi Province, China, differed from other known species in the Davalliaceae. *Davallia napoensis* F. G. Wang & F. W. Xing is herein described and illustrated as new to science. It is morphologically similar to *D. solida* (G. Forst.) Sw., but differs mainly by its rhizome scales that are triangular, with an obtuse apex and glabrous margin, the petiole of the lamina 20–24 cm long, and the widely crateriform and basifixed indusium.

Key words: China, *Davallia*, Davalliaceae, IUCN Red List.

The genus *Davallia* Sm. (Davalliaceae), with about 45 species, is widely distributed from the Atlantic islands through Africa and southern Asia to Malesia, southeast to Polynesia (Nootboom, 1996; Wu, 1999; Von Konrat et al., 1999). Kato (1985) provided a very detailed history of the generic delimitation until that time. The family Davalliaceae was historically classified into eight genera by Copeland (1908, 1927). Later, Kato (1985) recognized seven genera, with *Davallia* divided into three sections: section *Cordisquama* M. Kato, section *Davallia*, and section *Wibelia* (Bernh.) M. Kato, largely based on characters associated with the rhizome scales; in this classification, the generitype for *Humata* Cav. (*H. ophioglossa* Cav.), as well as several other species of *Humata* [= *Davallia* sect. *Humata* (Cav.) C. Presl], are included in *Davallia* sect. *Wibelia*. In 1989, Kato included *Scyphularia* Fée in *Davallia*; species formerly belonging to *Araiostegia* Copel. and *Humata* were also incorporated in *Davallia* (Nootboom, 1996). More recently, Kato and Tsutsumi (2008) divided *Davallia* into only two sections: section *Davallia* and section *Trogostolon* (Copel.) M. Kato & Tsutsumi, of which the former section included *Scyphularia*. There are about nine species of *Davallia* mainly distributed in southern and southwestern China (Ching et al., 1959; Wu, 1999; Wang & Xing, 2008).

During preparation of the taxonomic treatment of Davalliaceae for the *Flora of China*, Volume 3,

specimens of *Davallia* were collected and observed, some of which differed from established species in the genus. The new species is immediately distinguished by its rhizome scales that are triangular and obtuse at the apex, and indusia that are broadly bowl-shaped.

Davallia napoensis F. G. Wang & F. W. Xing, sp. nov. TYPE: China. Guangxi Prov.: Napo Co., Baidou, Nongbulin, near peak of evergreen broad-leaved forests, ca. 1200 m, 20 May 1989, *South China Expedition 841* (holotype, IBSC). Figure 1.

Species *Davalliae solidae* (G. Forst.) Sw. affinis, sed ab ea rhizomatibus 4–5 mm crassis squamis triangulatis apice obtusis marginibus glabris, stipite 20–24 cm longo, lamina late triangulato-ovata basi subrotundata segmentis ultimis ovato-triangulatis apice acutis atque indusio minore late crateriformi basifixo differt.

Plants 45–52 cm tall; rhizome robust, long-creeping, 4–5 mm thick, woody, dorsiventral, densely covered with overlapping scales; rhizome scales triangular, 4–5 × ca. 2 mm, margin glabrous, base truncate, apex attenuate to obtuse, rufous, peltate. Leaf remote, 2–4 cm apart on the rhizome; petiole 20–24 cm long, ca. 2 mm thick, brown, finely grooved adaxially, base densely covered with scales similar to those on the rhizome, sparser apically; lamina broadly triangular-ovate, 25–28 × 18–22 cm, base nearly rounded, apex acuminate, tripinnate or basally 4-pinnate pinnatifid; pinnae in 11 to 13 pairs, obliquely upward, spaced closely together, alternate or basal 1 or 2 pairs subopposite, with stalk 3–20 mm long, basal pair of pinnae largest, narrowly triangular-lanceolate, 15–16 × 4.5–5.5 cm, base broadly cuneate, apex long acuminate, with basal stalk ca. 2 cm long, bipinnate; pinnules in 10 to 12 pairs, alternate, anadromous, with a shortened petiole 5–6 mm, obliquely upward, spaced closely together, the basal pinnule largest, 1.8–2.1 × 0.7–0.9 cm, asymmetrically cuneate; ultimate leaflets in 6 to 8 pairs, alternate, with brief petiole or sessile, obliquely upward and closely opposed, the basal leaflet larger, 0.9–1.6 × 0.5–1 cm, ovate-triangular,

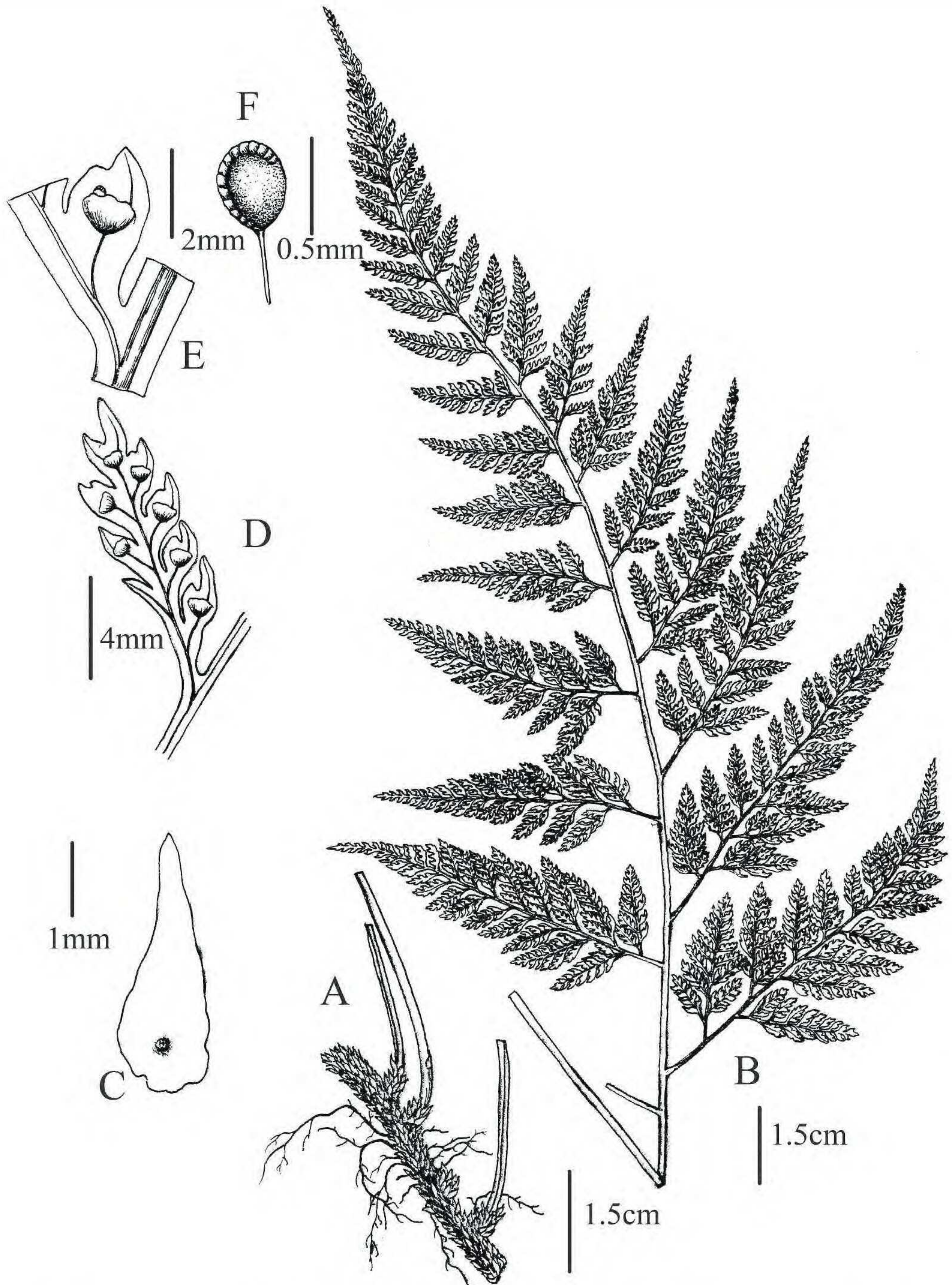


Figure 1. *Davallia napoensis* F. G. Wang & F. W. Xing. —A. Rhizome. —B. Leaf. —C. Rhizome scale. —D. Pinnule. —E. Ultimate lobes, with indusium. —F. Spore. Drawn by Yun-xiao Liu from the holotype *South China Expedition 841* (IBSC).

base obliquely cuneate and decurrent, apex acute; lobes entire, apex obtuse or with sinus, $3-4 \times$ ca. 1 mm; upper pinnae gradually shortened, lanceolate, 3-pinnate and shallowly pinnatifid, lobes entire,

terminal pinnae shortened to ovate-triangular, close together; veins inconspicuous, veinlets simple or forked, false veins absent; frond coriaceous or firmly papyraceous, brown when dry, smooth. Sori separate,

borne always one on the middle of pinnae segment; indusium widely crateriform, ca. 0.4×0.6 mm, entire, brown, membranous, basifixed, both sides free; annulus longitudinal, consisting of 13 to 16 thickened cells; spores monolete, elliptic, translucent.

Distribution and habitat. *Davallia napoensis* is currently known only from one locality in Napo County, Guangxi Province, China. It is an epiphytic fern and grows in humid environments on limestone substrates near the summit of a mountain, at ca. 1200 m elevation. The new taxon was found in association with the fern *Asplenium prolongatum* Hook. (Aspleniaceae), as well as *Ilex kwangtungensis* Merr. (Aquifoliaceae), *Ophiorrhiza japonica* Blume and *Porterandia sericantha* (W. C. Chen) W. C. Chen (Rubiaceae), *Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne (Lythraceae), *Stenosieris graciliflora* (Wall. ex DC.) C. Shih (Asteraceae), and *Tupistra fungilliformis* F. T. Wang & S. Yun Liang (Liliaceae).

IUCN Red List category. *Davallia napoensis* is only known from a single locality and has a small population size. Therefore, it is assessed here as Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The specific epithet is derived from Napo County, where the holotype of *Davallia napoensis* was collected.

Taxonomic relationships. According to the sectional classification of Kato and Tsutsumi (2008), *Davallia napoensis* should be assigned to *Davallia* sect. *Davallia*, based on the glabrous scale margin and the basifixed indusia.

Morphologically, *Davallia napoensis* closely resembles *D. solida* (G. Forst.) Sw. (Wu, 1999: plate 32, 1–6), which is widely distributed in Guangdong, Guangxi, Yunnan, and Taiwan provinces of China, as well as Burma, Malesia, the Philippines, Polynesia, and Thailand, in dense forests at altitudes of 500–1400 m. *Davallia solida* is distinguished by having tripinnate fronds (vs. tripinnate or basally 4-pinnate pinnatifid in *D. napoensis*), a more robust rhizome that is also long-creeping, and brown (vs. rufous), overlapping rhizome scales. *Davallia solida* is further differentiated by the thicker rhizome, 8–10 mm diam. (vs. 4–5 mm diam. in *D. napoensis*); the ovate-lanceolate rhizome scales, 5–7 mm long, with a long subulate apex and ciliate margin (vs. triangular rhizome scales, with an attenuate to obtuse apex and glabrous margin); the petiole 15–18 cm long (vs. 20–24 cm); the lamina quinquangular (vs. broadly triangular-ovate) with the base cordate (vs. nearly rounded); the elliptic ultimate leaflets with an obtuse apex (vs. ovate-triangular leaflets with an acute

apex); and the indusia attached along the sides, tubular, and longer than wide, $1.2\text{--}2 \times 0.5\text{--}1$ mm (vs. smaller indusia that are basifixed, crateriform, ca. 0.4×0.6 mm in *D. napoensis*). Another similar species is *D. formosana* Hayata (Ching et al., 1959; Wu, 1999), distributed in Fujian, Guangdong, Guangxi, Hainan, Taiwan, and Yunnan provinces in China and south into Vietnam and Cambodia in forests at 600–700 m altitude. *Davallia formosana* is similar to *D. napoensis* in its general plant aspect, but is distinguished by its widely lanceolate, shaggy rhizome scales, with a long acuminate apex and ciliate margin, ca. 1 cm long; its tubular indusium attached along the sides, ca. 1×2 mm; its rhizomes ca. 1 cm thick; and its petioles 25–55 cm long. *Davallia formosana* is the largest of the three species, with fronds 4-pinnate, triangular or ovate-triangular, $55\text{--}90 \times 55\text{--}90$ cm, and with a cordate base.

Davallia napoensis is also similar to *D. griffithiana* Hook. (Wu, 1999), which is distributed in Yunnan and Taiwan provinces in China and in India climbing on trunks or rocks in wet forest. *Davallia griffithiana* resembles *D. napoensis* in having a long-creeping rhizome and widely crateriform indusium, but is distinguished by its linear-lanceolate rhizome scales with a long acuminate apex (vs. triangular with an attenuate to obtuse apex), its petiole 10–15 cm long (vs. 20–24 cm long), the lamina 16–25 cm long (vs. 25–28 cm long), and the indusium attached by the base and at least halfway along the sides (vs. basifixed with both sides free).

Spore morphology observations show that the epispore of *Davallia napoensis* and related species are irregularly verrucate, with obviously smooth verrucae that differ in size (Fig. 2). However, the spore verrucae of *D. napoensis* are smooth, whereas those of *D. solida*, *D. griffithiana*, and *D. formosana* have a thin, rough covering.

Paratypes. CHINA. **Guangxi:** Napo Co., Baidou, Nongbulin, near peak of evergreen broad-leaved forests, *South China Expedition 841* (IBSC).

Representative specimens of compared species include:

Davallia solida (G. Forst.) Sw. CHINA. **Yunnan:** Hekou, K.-H. Cai 1184 (PE); Guangxi, Yao Mtn., Y.-C. Wu 651 (PE). VIETNAM. 3 islands, *Sino-Vietnam Exped. 2086* (PE).

Davallia griffithiana Hook. CHINA. **Taiwan:** Wenshan, Tarako et al. 136 (PE). **Yunnan:** Xichou, Z.-R. Wang 498 (PE).

Davallia formosana Hayata. CHINA. **Guangdong:** Luofu Mtn., N.-Q. Chen 41276 (IBSC). **Hainan:** Bawangling, Z.-X. Li 3566 (IBSC). **Yunnan:** s. loc., G.-H. Shing et al. 6179-3 (PE).

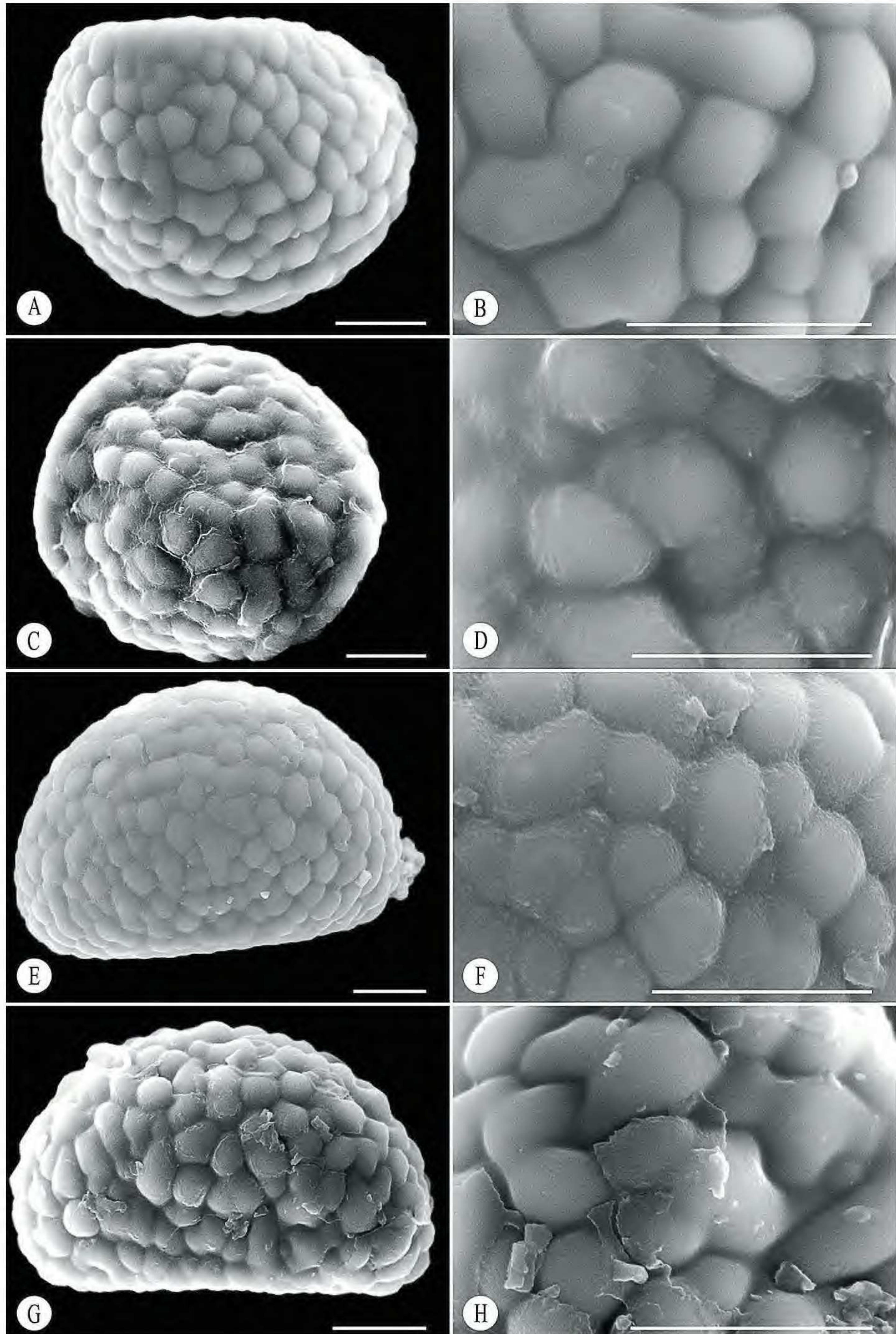


Figure 2. SEM photographs of *Davallia* spores. —A, B. *D. napoensis* (spore from the holotype of *South China Expedition 841* [IBSC]: A, $\times 1900$; B, $\times 6000$). —C, D. *D. solida* (spore from *K.-H. Cai 1184* [PE]: C, $\times 1800$; D, $\times 6000$). —E, F. *D. griffithiana* (spore from *Z.-R. Wang 498* [PE]: E, $\times 1900$; F, $\times 5500$). —G, H. *D. formosana* (spore from *G.-H. Shing et al. 6179-3* [PE]: G, $\times 1700$; H, $\times 6000$). Scale bars = 10 μm .

Acknowledgments. We are grateful to Victoria C. Hollowell and the reviewers for their suggestions and critical remarks on the manuscript, and we thank the herbaria IBSC, KUN, PE, and SYS for allowing us to examine their materials. The study was supported in part by the National Natural Science Foundation of China (30800056), the Knowledge Innovation Program of the Chinese Academy of Sciences (KSCX2-YW-Z-022), and the Director Foundation of the South China Botanical Garden, Chinese Academy of Sciences, to the first author (200607). Yun-xiao Liu and Shu-gang Chen are thanked for drawing the illustration.

Literature Cited

- Ching, R. C., S. H. Fu, C. H. Wang & G. H. Shing. 1959. Davalliaceae. Pp. 280–319 in S. S. Chien & W. Y. Chun (editors), *Flora Reipublicae Popularis Sinicae*, Vol. 2. Science Press, Beijing.
- Copeland, E. B. 1908. New or interesting Philippine ferns III. *Philipp. J. Sci.*, C 3: 31–39.
- Copeland, E. B. 1927. *Davallodes* and related genera. *Philipp. J. Sci.* 34: 239–257.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Kato, M. 1985. A systematic study of the genera of the fern family Davalliaceae. *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 13: 553–573.
- Kato, M. 1989. Taxonomic studies of pteridophytes of Ambon and Seram (Moluccas) collected by Indonesian Japanese Botanical Expeditions, Davalliaceae and Oleandraceae. *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 14: 222–226.
- Kato, M. & C. Tsutsumi. 2008. Generic classification of Davalliaceae. *Acta Phytotax. Geobot.* 59(1): 1–14.
- Nooteboom, H. P. 1996. Davalliaceae of China. *Acta Phytotax. Sin.* 34(2): 162–179.
- Von Konrat, M. J., J. E. Braggins & P. J. de Lange. 1999. *Davallia* (Pteridophyta) in New Zealand, including description of a new subspecies of *D. tasmanii*. *New Zealand J. Bot.* 37(4): 579–593.
- Wang, F. G. & F. W. Xing. 2008. Proposal to conserve the name *Davallia sinensis* (Christ.) Ching against *D. chinensis* (L.) Sm. (Davalliaceae). *Taxon* 57(3): 644–645.
- Wu, S. H. 1999. Davalliaceae. Pp. 161–199 in S. H. Wu & C. H. Wang (editors), *Flora Reipublicae Popularis Sinicae*, Vol. 6(1). Science Press, Beijing.